Asian Academy of Management Journal, Vol. 23, No. 2, 125–141, 2018

MARKET STRUCTURE OF MALAYSIAN PALM OIL REFINING INDUSTRY

Choo Sze Yi[1]*, Alias Radam[1], Azman Hassan[1], and Mad Nasir Shamsudin[2]

[1]Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[2]Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

*Corresponding author: szeyi.choo@gmail.com

Published online: 21 December 2018

To cite this article: Choo, S.Y., Radam, A., Hassan, A., and Shamsudin, M.N. (2018). Market structure of Malaysian palm oil refining industry. *Asian Academy of Management Journal*, *23*(2), 125–141. https://doi.org/10.21315/aamj2018.23.2.6

To link to this article: https://doi.org/10.21315/aamj2018.23.2.6

ABSTRACT

Palm oil refining industry has become one of the most important industries in Malaysia since 1960s. In the second quarter of 2018, total production and total exports of Malaysian palm oil products recorded low-single digit drop, despite an encouraging recovery in production in 2017. It is worrying to note the declining trend of utilisation rate of these refineries over the years signifying the loss of market share of these refineries in the global market. This study aims to focus on determining the structure of the industry using six concentration indicators namely Herfindahl-Hirschman index (HHI), concentration ratio (CR), entropy index (EI), relative entropy (RE), Hannah and Kay index (HKI), and the Gini coefficient (GINI). The results obtained indicate that the industry is an oligopoly with apparent shift from a highly indexed oligopoly to a lower indexed oligopoly during the studied period. The results further affirmed the concern raised in this study that the domestic palm oil refining industry has lost its market share and position in the international market.

Keywords: concentration indicators, market structure, Malaysian palm oil refining industry, oligopoly, market share

INTRODUCTION

Palm oil refining industry plays the most important role in the country's economy and in the palm oil industry itself. Based on Malaysia Standard Industrial Classification 2000 (MSIC) by the Department of Statistics Malaysia, palm oil refining industry is grouped under Division 15 in manufacture of food products and beverages. This is associated with the value added and quality of processed palm oil (PPO) after going through the refining process. Palm oil that undergoes the refining process can be sold at higher prices as well as for other further usage. Incentives and promotion by government in the early days were believed to have driven and influenced refiners to enter the industry following rapid increase in the number of refineries in operation in the 1980s (Ahmad, 2012).

The cultivation of palm oil was rapid in 1960s as government took heed of the suggestion by World Bank mission to reduce the reliance of the nation's economy in tin mining and rubber. Tin mining industry was threatened in terms of exhaustion of resources, uncertainties in commodity prices, and aggressive competition from other producers. In the case of rubber, the sharp fall in the prices of rubber and the innovation of synthetic rubber added to the cause that further dimmed the future of this commodity, be it in the global market or in the economy of Malaysia. Other palm oil producer countries doubted Malaysia's ability to achieve comparative advantage in producing PPO. Malaysia had however taken the step of faith to promote downstream activities through investment incentives given to pioneer refiners.

Malaysia then had the world's largest palm oil refining industry with the establishment of 15 refineries in 1976 producing a capacity of 800,000 tonnes. A year later, in 1977, up to one million tonnes of palm oil were refined whereby 890,000 tonnes were crude palm oil (CPO) (Gopal, 1999). Refining factories began to flourish at that time. Some refiners ventured into large-scale production of oils and fats for the purpose of export. The number of refineries was growing gradually over the years from 15 refineries in 1976 to 51 refineries in five years' time, producing a capacity of 1.0 million tonnes to 3.5 million tonnes, respectively.

However, in 1984, the number of refineries reduced from 55 to 35 with a capacity amounting to 5.35 million tonnes. The drastic drop in the number of palm oil refining factories was caused by the soy oil producers launching a worldwide health campaign in United States and in other countries to increase the demand of the latter by severely reducing the import of the former (Hasan, 2007). In addition to that, the European countries discouraged the import of Malaysian palm oil products by reducing the prices of vegetable oils in which the demand of vegetable

oils rose sharply as palm oil was costlier compared to vegetable oils. It was in the late 1980s and early 1990s that this condition improved as a result of negative impact of consumption of hydrogenated vegetable oils. This caused consumers to switch to palm oil instead. Since then palm oil refining industry continued to grow, where the total number of refineries increased to 74 and 75 in 1987 and 1988, respectively. The capacity produced peak in 1987 with 14.28 million tonnes, which signified that refineries were producing at economies of scale. Refineries were said to refine CPO in a large bulk (Gopal, 1999). The positive growth of palm oil refining industry reflected the affirmative result of government's intervention in developing the industry domestically to compete internationally. A brief illustration of total production, export, import, and domestic palm oil consumption for the period of 2010 to 2018 is presented in Figure 1.

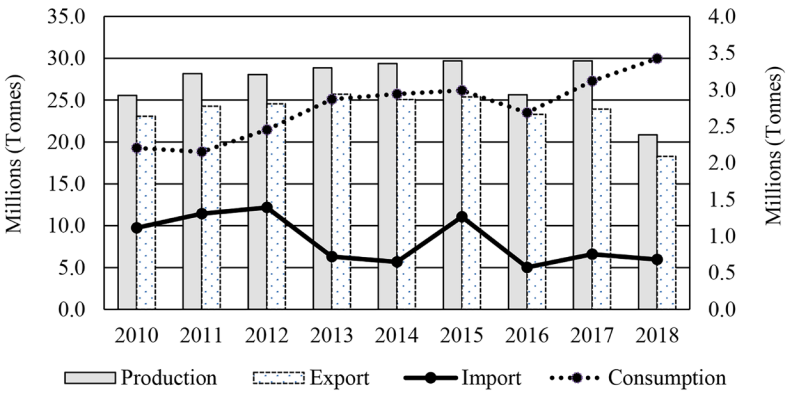

Figure 1. Total production, export, import, and domestic palm oil consumption, 2010–2018[a]

Sources: MPOB (2018) and USDA (n.d.)
Note: [a] Data as of September 2018

The capacity utilisation rate achieved by domestic refineries has been showing a downward trend where it plunged to the historic low of 54.29% in 2012. It is worrying to note the declining trend of utilisation rate of these refineries over the years. Domestic refiners would lose their market share in the global market if the drop in production level persists. In relation to analysis by Ng (2012), palm oil refining industry's competitiveness is questioned and the future of this industry is rather bleak if Malaysia does not fight to sustain its market share and position in the global market. The main purpose of this paper is to determine the market structure of the Malaysian palm oil refining industry through empirical analysis of 52 refining firms in the industry. This study offers insights on competition in domestic palm oil refining industry that will help policy makers in formulating policies for the interest of domestic refineries in the country.

LITERATURE REVIEW

The central point of the field of industrial organisation lies in the studies of market structure of an industry. Structure is the characteristics that explain the market in terms of the number of firms and buyers, entry barriers that existed in the market, size of the firm, market share, and competition among firms. These characteristics would draw the picture of the performance and competition of firms in the market as according to Bain (1956). He added that concentration and entry barrier are the most conventional characteristics to study the structure of any given market.

According to Bain (1956), concentration ratio is an important element in studying market structure. It signifies the degree to which firms in the industry hold market power. Firms with high degree of market power have the ability to raise prices and earn high profits in the process. Market share is often used to illustrate the degree of market power a firm holds in the industry. In analysing the behaviours of firms in the market, particularly apparent in the oligopolies industries, firms compete with one another in establishing market power by gaining more market share. By enhancing their market share, established firms deter entry of potential entrants following studies contributed by Ukav (2017), Viseur (2016), Barham and Ware (1993), Waldman (1991), Brock and Scheinkman (1985), and Heflebower (1967).

Following that, Duetsch (1975) adopts four-firm concentration ratio in studying the structure, performance, and entry of firms into manufacturing industries. He found that market with high concentration ratio attracted entry of new firms, as profit rates were higher in this market. On the other hand, the work by Cowling and Waterson (1976) established that Herfindahl index was a better method in measuring concentration ratio than four-firm concentration ratio. They argued that the results of Herfindahl index explained the concentration of an industry and the market outcome well.

In studying structure and concentration of a market, Sukpaiboonwat, Piputsitee, and Punyasavatsut (2014), Martin (2010), and Church and Ware (2000) suggested the employment of Herfindahl index. They implied that Herfindahl index takes into account the variation in terms of sizes of firms while four-firm and eight-firm concentration ratios fail to do just that. The conventional calculation of concentration ratio also does not provide fair distribution of market shares of firms that would have caused bias in indicating the exact level of competitiveness of firms in the market. Hence, they affirmed that Herfindahl index contributes to reflect a clearer picture of firm concentration in the market as well as interpretation of Herfindahl index compared to four-firm and eight-firm concentration ratios.

The empirical work of Charumbira and Sunde (2010) combined several market concentration indices in studying the market structure of grain milling industry in Zimbabwe from 1985 to 2005. The concentration indices of their studies were inclusive of concentration ratio, Herfindahl index, Hannah and Kay index (HKI), and entropy index (EI). They concluded that the four concentration indices used in their studies were consistent to affirm that Zimbabwe's grain milling industry fell into the category of concentrated oligopoly. Their studies also showed that competition did encourage entry of several new firms in the industry that reduced the concentration levels in the industry.

In studying the international construction market, Ye, Lu, and Jiang (2009) opted four major concentration indices to measure the concentration of the said industry from 1981 to 2008. Accordingly, the indicators used to measure the concentration level of the international construction market were concentration ratio, Herfindahl index, Gini coefficient (GINI), and EI. Their empirical findings concluded that the concentration level of construction market was consistent across four indices used and was categorised as moderate, with healthy competition among major firms in the industry. In addition to these four concentration indices, Ukav (2017) suggested the use of Lorenz curve and Rosenbluth index in studying various industries in Turkey.

The empirical studies measuring competitiveness and concentration of major companies in 13 industries ranging from software, telecommunication, communication equipment, computers, semiconductor equipment, bank, airlines, beverages, financials, retail, utilities, oil and gas, and drugs manufacturers. The extensive studies of Nawrocki and Carter (2010) adopted indices such as Herfindahl index, EI, and relative entropy for the period of 1971 to 2001. The empirical findings indicated that firm's return was directly affected by the competitiveness of the industry in which high concentration yield high returns for most firms.

The structure-conduct-performance paradigm has been the core of industrial economics. In studying the structure of an industry, economists measure the level of concentration through the commonly used Herfindahl index and concentration ratio, and the least used indices such as the EI, HKI, GINI, and relative entropy. The market structure of an industry is determined through analysis of concentration of a particular industry, in which concentration will determine the competitiveness of firms and the market structure of the industry.

METHODOLOGY

In studying the structure of a market, concentration ratio is observed to determine the degree of competition of firms in the market. Concentration ratio of a market is crucial in influencing potential entrant's decision and plan to enter. When the industry has only a few firms, that is, when concentration ratio is high, new entry is unlikely to occur. Overseeing the threat of new entry, incumbents would collude to form market power to delay or prevent new firms from entering. Collusion of firms in highly concentrated industry would be a deadly intimidation to new firm upon entering, as the former would cut prices and increase capacity to reduce new firm's return. Entry in highly concentrated market is less likely as the market signifies high competition level from firms and limited growth opportunities for new firms to explore.

With regard to the discussion above, Sukpaiboonwat et al. (2014), Günalp and Cilasun (2006), Bunch and Smiley (1992), and Cotterill and Haller (1992) pointed out that potential entrants were less likely to invade highly concentrated industries. Given the high competitiveness in the market and the issue of market power by incumbents, entrants would prefer to not enter the market. By looking at these evidences, this variable is estimated to bear the negative sign related to entry.

Herfindahl-Hirshman index (HHI), often referred to as Herfindahl index, is calculated by taking sum of market share of all firms in the market as:

$$\begin{aligned} HHI &= s_1^2 + s_1^2 + \ldots + s_n^2 \\ &= \sum_{i=1}^{N} S_i \end{aligned} \tag{1}$$

where, N equals the number of firms in the market and S_i represents the market share of the particular firm in the market. The structure of the market is determined based on Herfindahl index measuring from zero (0) to one (1). When the market is in perfect competition with many firms in the market, the index is said to be zero. On the other side, when the Herfindahl index is one, the structure of the market is known to be a monopoly. As the index grows bigger in number, the lesser the number of firms in the industry, the more market share firms in the industry hold, the higher the concentration ratio of the industry, the lesser the event of entry occur. Following Church and Ware (2000), in taking account of variation of firm sizes,

$$HHI = 1/N + N\sigma^2 \tag{2}$$

in which, σ^2 denotes the variance of firm sizes. Following Church and Ware (2000), both changes in the number of firms and the variation of firm sizes would cause changes in Herfindahl index as well. It is important to note that Herfindahl index gets larger as the variation or distribution in terms of the sizes of the firms gets bigger.

Concentration ratio (CR) is a common ratio used to measure the cumulative degree of concentration in the market as:

$$CR_k = \sum_{i=1}^{k} S_i \tag{3}$$

in which, k represents the number of largest firms in the industry and S_i equals the market share of the firms in the industry. Usually, the four largest firms in the market is used to measure the ratio, which is also known as CR_4. The CR ranges from zero (0) to one hundred (100), where zero indicates no concentration or perfect competition, while the ratio of one hundred indicates total concentration or monopoly. As the ratio grows bigger, the market becomes concentrated indicating firms have more control and more market power in the industry and vice versa.

EI is another index used to measure market concentration and competition which is given as:

$$EI = \sum_{i=1}^{n} S_i ln\left(1/S_i\right) \tag{4}$$

where, n equals the number of firms in the market and S_i represents the market share of the particular firm in the market. The EI ranges from zero (0) to, $ln\ n$ and it is therefore not restricted to [0,1] (Kramaric & Kitic, 2012; Bikker & Haaf, 2002). In other words, the maximum value that can be taken by the EI in the case of firms with equal market shares and when the market concentration is at the lowest would be the *ln* value of the number of firms in the market (Kramaric & Kitic, 2012; Ferguson & Ferguson, 1994). The EI has an inverse relationship with the concentration level, where index of zero (0) indicates that the market is a monopoly while the smaller the value of EI signifies that the more concentrated the market is and vice versa.

EI is often adopted to measure the competition level or the degree of competition of firms in the industry by measuring the level of uncertainty of the market. As quoted, EI is a measure of "the degree of disorder, uncertainty, or randomness in a system" (Horowitz & Horowitz, 1968). According to Barthwal (2004) and George, Joll, and Lynk (2000), a higher index that indicates a less concentrated market with more competition would signify the existence of uncertainty in the

market in which firms have little control over the market. Likewise, a monopoly market represented by index zero (0) takes on the meaning that the degree of uncertainty is equal to zero or is non-existence.

As mentioned, EI is used to measure the competition level of firms in the industry; relative entropy measures the actual degree of dispersion of market share by taking into account the number of firms in the industry (Nawrocki & Carter, 2010; Barthwal, 2004). Relative entropy (RE) is given as:

$$RE = EI / ln\, n \tag{5}$$

where, *EI* is the entropy index, *n* is the number of firms in the market, and *ln n* is the maximum entropy value. The RE ranges from zero (0) to one (1), whereas the value gets smaller, the market become concentrated and vice versa.

HKI is an index commonly used to measure market concentration and is given as:

$$HKI = \sum_{i=1}^{n} S_i^{\alpha} \tag{6}$$

where, $\alpha > 0$; $\alpha \neq 1$, *n* equals the number of firms in the market, S_i represents the market share of the firms in the market, and α refers to elasticity parameter and to be determined freely in order to reflect about changes in concentration on entry and exit of firms (Bikker & Haaf, 2002). As stated by Hannah and Kay (1977), for a sensible result, it is suggested that the α value range from 0.6 to 2.5 (Charumbira & Sunde, 2010; Bikker & Haaf, 2002; Ferguson & Ferguson, 1994). Following OECD (2013) and Charumbia and Sunde (2010) as the value of $\alpha = 2$ would yield the same result as HHI, HKI is often referred to as HHI. The value of HKI is similar to that of HHI ranges from zero (0) to one (1), in which the value of zero indicates perfect competition and the index of one signifies a monopoly. The focus of HKI lies upon the distribution effect of the firms in the market where Hannah and Kay (1977) suggested that the concentration of the market would be affected with the changes in the number of firms in the market.

GINI evaluates the market concentration of the industry through measuring the market share of firms in the industry and it is given as:

$$GINI = \sum_{i=1}^{n} S_i / 1 + n(1 - S_i) \tag{7}$$

where, *n* represents the number of firms in the market, and market share of S_i. Similarly, the value of GINI ranges from zero (0) to (1), where the value of one represents a monopoly with complete control of the market, while the value of

zero indicates that firms in the market is equally distributed with little control over the market. GINI measures the distribution of firm sizes in relation to the firm's market share. With an even distribution in the market share, firms have little dominance in the industry as compared to uneven distribution in the market share which signifies dominance and control over the industry. The market power held by firms reduces as the number of firms in the industry increases.

This study employs a total of 256 financial statements obtained from Companies Commission of Malaysia (CCM), where these financial reports are extracted according to the suitability and availability solely for the purpose of academic research. The variable used is the revenue sales of individual firm for each year that is then converted to represent the market share of each firm in the industry and is later summed up as the total market share of all firms. In the case where discrepancies arise from the number of refineries in operation as reported by MPOB and the actual financial statement reports acquired, the number of refineries in operation is established based on the statistics as the numbers captured by MPOB are deemed accurate to reflect the actual condition of the industry.

RESULTS AND DISCUSSION

The structure-conduct-performance paradigm has been the core of industrial economics. In studying the structure of an industry, economists measure the concentration through HHI, CR, EI, RE, HKI, and GINI. The market structure of an industry is determined through analysis of concentration of a particular industry. Concentration ratios are often used to determine the competitiveness of firms and the market structure of the industry.

The analysis of this study involves a total of 52 firms in which the activity carried out by these firms is mainly refining of palm oil from 2005, where Malaysia was then the number one producer in the world to 2013, when government took initiative to boost competitiveness of domestic downstream producers following Indonesia's policy change in 2011. These firms are divided into two categories namely the public listed and the non-public listed firms, in which the public listed firms take up 67% while the non-public listed firms account for the remaining 33%, equivalent to 17 firms. These public listed firms are mainly owned by 19 parent companies listed in the Bursa Malaysia. Public listed firms remain the largest contributors to the industry sales with the total sales worth RM37.3 billion in 2005 which accounted for 90.9% of the total industry sales before topping the chart in 2008 with double-folded sales of RM80.8 billion. The total sales of public listed firm however declined by 2.2% in 2009 due to the huge drop in the prices of palm

oil. The total sales amount bounced back to record high of RM85.6 billion in 2011 before fluctuating again to account for 87.4% of total industry sales equivalent to RM71.9 billion in 2013.

On the other hand, the non-public listed firms accounted for a mere 9.1% of the total industry sales in 2005. Figure 2 illustrates the total industry sales based on public listed and non-public listed firms in the period of 2005 to 2013. The contribution of non-public listed firms grew to RM0.83 billion, which accounted for 10.3% of the industry sales in 2008. The total sales of non-public listed firms in the palm oil refining industry illustrates a fluctuating pattern over the observation years probably due to the unstable palm oil prices in the world market. The total sales of non-public listed firms are worth RM0.91 billion, making up 12.6% of the total industry sales in 2013. A brief descriptive statistics summary on the concentration analysis is presented in Table 1 for 52 palm oil refining firms in Malaysia in the period of 2005 to 2013.

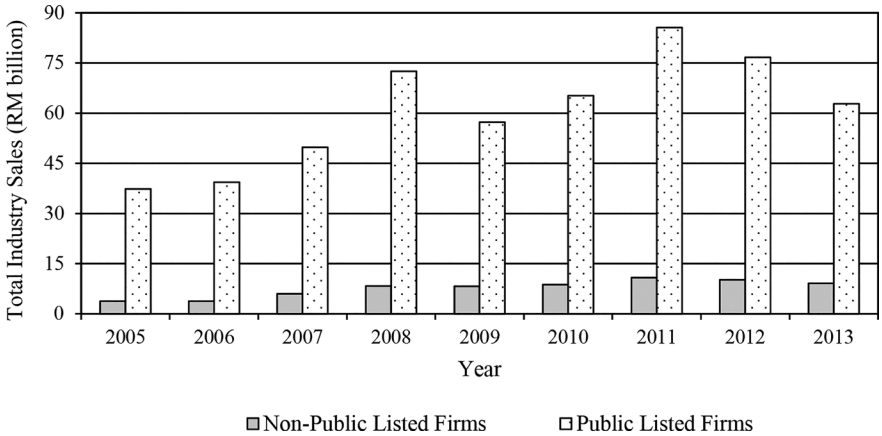

Figure 2. Total industry sales based on public listed and non-public listed firms, 2005–2013

The results from the concentration indicators illustrated in Table 2 categorised Malaysian palm oil refining industry as an oligopoly across the various concentration indices. According to Ahmad (2012) and Abdul Jalil (1996), given that the industry has moderate to high government intervention and the existence of excess capacity, it is further affirmed that the domestic palm oil refining industry that falls under manufacturing is indeed an oligopoly. Following that, Choo and Abdul Jalil (2014) concluded that government intervention in terms of operational policy, production capacity, and licensing of entrance of firms exist in Malaysian palm oil industry.

Table 1
Descriptive statistics of concentration analysis summary

	HHI	CR_4	CR_8	EI	RE	$HKI^{0.6}$	$HKI^{1.5}$	$HKI^{2.5}$	GINI
Mean	1462.92	71.56	86.21	2.18	0.55	45.35	356.25	6397.31	0.83
Median	1479.34	71.21	85.65	2.22	0.56	45.69	357.10	6548.89	0.83
Std. dev	81.88	2.61	2.38	0.10	0.02	1.57	12.01	467.65	0.01
Min	1316.59	67.54	83.19	2.04	0.52	42.58	335.98	5539.17	0.82
Max	1565.74	75.34	90.34	2.36	0.59	47.49	373.13	6914.35	0.85

Table 2
Concentration indices for all firms, 2005–2013

Year	HHI	CR_4	CR_8	EI	RE	$HKI^{0.6}$	$HKI^{1.5}$	$HKI^{2.5}$	GINI
2005	1558.94	75.34	85.81	2.2045	0.5695	2.7304	0.3711	0.0690	0.8206
2006	1539.20	75.24	85.33	2.2259	0.5661	2.7789	0.3686	0.0675	0.8305
2007	1511.06	72.63	82.93	2.3028	0.5828	2.8815	0.3605	0.0676	0.8277
2008	1471.57	71.21	81.73	2.3392	0.5920	2.9272	0.3549	0.0653	0.8253
2009	1360.90	69.14	81.05	2.4018	0.6109	2.9814	0.3422	0.0578	0.8177
2010	1442.14	70.65	81.86	2.3759	0.6043	2.9648	0.3499	0.0638	0.8242
2011	1484.12	72.17	83.27	2.3239	0.5853	2.8935	0.3569	0.0659	0.8400
2012	1414.89	70.11	82.39	2.3868	0.5983	2.9674	0.3472	0.0618	0.8387
2013	1306.56	67.54	81.53	2.4647	0.6151	3.0458	0.3332	0.0551	0.8338

An oligopoly industry signifies a medium concentrated industry with less competition and firms have significant market power over the industry. It is however noteworthy that despite remaining in the oligopoly industry, the concentration of Malaysian palm oil refining industry has shifted from being a highly indexed oligopoly industry to a lower indexed oligopoly industry over the span of eight years. This is consistent across the various concentration indices as shown in the Table 2, further affirming the notion of Malaysian palm oil refining industry being an oligopoly industry. As the PPO is considered a homogenous product where it is not differentiated, the Malaysian palm oil refining industry is classified as a pure oligopoly or perfect oligopoly, similar to that of cement, steel or aluminium industry. In addition, May (2012) and Hueth and Marcoul (2006) noted that agricultural commodities such as palm oil, vegetables, and fruits manufacturing are classified as oligopoly.

The decline in the concentration indices across Table 2 since 2006 is consistent to the event where Malaysia lost its position as the world's largest palm oil producer to Indonesia. Back then in 2005, Malaysia was still in her glorious position in the

world market ahead of Indonesia. As a result, according to Department of Statistics Malaysia (2018), the production of domestic refined palm oil in 2006 experienced a slight dip due to weaker demand for domestic refined palm oil. This is projected clearly in the weaker concentration indices of domestic palm oil refining industry in 2006.

The concentration indices have depicted gradual decline over the years where in 2009 these indices fell to historic low against previous years. This is believed to be caused by the international financial crises in 2008 in that the aftermath of this worldwide crisis left the global economy and the Malaysian economy with the historic worst contraction since World War II (Bank Negara Malaysia, 2010; Abidin & Rasiah, 2009). According to these reports, manufacturing sector was one of the most hit sectors in Malaysia since the outburst of the global economy crisis. With the uncertainty in the global market, the commodity prices, especially palm oil, continued to drop in 2008 causing the sales of domestic palm oil refiners to decline sharply before recovering progressively in second half of 2009. The concentration indices for Malaysian palm oil refining industry had thus bounced back in 2010 as a result.

According to Ye et al. (2009), as the minimum value of EI is conventionally zero (0), the maximum value of EI however is not restricted to one (1) as it is determined by the number of firms (*ln n*) in the industry. Although this study only recorded analysis of 52 refineries, considering the number of refineries in operation based on statistics by MPOB, where in this case, there are 55 refineries in operation in 2013, the maximum value of EI takes the form of *ln* 55 which is given as 4.007. The entropy value of 2.4647 in 2013 is approximately 61.51% relative to the maximum value of *ln* 55, where the industry is interpreted as an oligopoly. As discussed earlier, the entropy value has an inverse relationship with the concentration level, whereas the value of entropy increases, the concentration of the industry decreases.

Alternatively, the EI is also used to measure the level of uncertainty of the said market, in which the entropy values suggested the existence of uncertainty in the palm oil refining industry. The progressive increase in the EI has yet again supported the notion that firms in the industry have lesser control over the market following the increase in the level of uncertainty in the industry as a whole. RE on the other hand is an easier index to interpret, where it takes the form of zero (0) to one (1) with zero being the monopoly and vice versa. The RE exhibits a similar trait where the value has continued to increase further affirming the findings of HHI, concentration ratios, and EI in the palm oil refining industry in Malaysia.

Following Hannah and Kay (1977), the value of α that ranges from 0.6 to 2.5 would yield a sensible result, therefore this study employs the values of 0.6, 1.5, and 2.5 in the analysis. The greater the value of α is assigned, the more weight the result is given to the larger firms. It is worth noting that the value of α determines the weight of firms in the analysis where a higher indicates more weight is assigned on the large firms and vice versa. Therefore, the findings of HKI $\alpha = 0.6$ in this study imply that the palm oil refining industry is a highly concentrated industry as reflected in the small values of HKI in the observation years. This result is consistent to that of the condition of the palm oil refining industry as the market power is held by only a handful of large firms. The result of HKI $\alpha = 1.5$ showed that the concentration level in the industry have increased slightly although it still remains in the category of high concentrated industry. As the $\alpha = 2.5$ gives weight to large firms, the HKI indicates that the Malaysian palm oil refining industry has fallen to the category of low concentrated industry. As stated by Charumbira and Sunde (2010), the choices of α caused the findings of market concentration for HKI to be inconclusive. Therefore, it is affirmed that HKI does not prove consistent and conclusive findings to measure the industry concentration of Malaysian palm oil refining industry.

The new policy implementation by Indonesia in 2011 as a move to boost its refining industry through reducing the PPO export duty and increasing the CPO export tax, followed by Malaysian government lifting export tax of CPO have clearly hurt Malaysian palm oil refining industry. Subsequently, the concentration and market share for all firms have fluctuated across various indices in recent years. Non-public listed firms and small public listed firms were among the firms that were hit the most as these firms have little ability to compete with foreign competition. The zero export duty of CPO has caused upstream industry to export CPO out of the country, leaving domestic refiners with limited supplies of CPO. Consequently, export duty on CPO was raised to 4.5% in March 2013 providing domestic refiners with more leverage to compete in the global market.

As these concentration indices take into account the market sales to measure the market share and market power of an industry, the decline in the sales of Malaysian palm oil refining industry has significantly impacted the market share held by these firms, thus illustrating that these firms have lost the grip of their market power. In recent years, the domestic palm oil refining firms have faced tough and challenging competition from one another and from refining firms abroad, especially from Indonesia.

As GINI is also used to measure the distribution of the firm sizes as stated in the literatures, following the higher indices values in the empirical results, it indicates

that the firm sizes is not equally distributed. Accordingly, it is stated by Ye et al. (2009) that as the GINI appears closer to one (1), the industry is less equally distributed and vice versa, where the value of zero (0) indicates perfect equality while the value of one (1) signifies perfect inequality in terms of firm's distribution. As stated by Ginevičius and Čirba (2007, 2009), with the increase in the number of firms in the industry, the uncertainty of firms is expected to intensify as firms are required to compete with one another. It is true that the big public listed firms in the domestic palm oil refining industry are facing tough competition from small non-public listed firms and held lesser market power as compared to earlier years.

CONCLUSION

Evidences from concentration indicators of HHI (1306.56), CR_4 (67.54), EI (2.4647), RE (0.6151), HKI (3.0458), and GINI (0.8338) on all 52 firms in 2013 indicate that the Malaysian palm oil refining industry falls in the oligopoly category. The structure of the said industry indicates that this industry falls under the oligopoly category where the condition of the market as a whole has clearly displayed traits of a weakened oligopoly concentration in the recent years. Both public listed and non-public listed firms are indeed struggling to survive in the world market. The empirical results of this study are evident to verify Palm Oil Refiners Association of Malaysia's (PORAM) claims that our domestic palm oil refineries are facing intense competition and losing their market share in the global market (Ahmad, 2012). This study provides empirical evidence and references for policy makers and regulators' decision making process in further developing plans to ensure that our domestic palm oil refining industry remains significant players in the global market.

As findings of this study indicate that firms' market share continued to shrink, policy makers and regulators ought to formulate policies to encourage continuous healthy competition among refineries in the domestic arena. For instance, in enhancing firms' competitive level, policy makers and regulators should encourage these firms to achieve vertical integration so as to remain competitive in the industry, domestically and globally. It is believed that moving forward, the palm oil refining industry is expected to face challenges with fierce competition from Indonesia, stagnant PPO demand from India and China, the sustainability issues raised by European Union and the productivity issues of domestic refineries. Policy makers and regulators ought to encourage refineries to be involved in plantation, milling, refining, and other downstream sub-sectors for a complete supply chain to enjoy additional economic gains from cheaper inputs and materials for refining processing.

REFERENCES

Abdul Jalil, S. (1996). Capacity utilisation in the Malaysian palm oil refining industry. Unpublished PhD dissertation, Universiti Putra Malaysia, Selangor, Malaysia.

Abidin, M.Z., & Rasiah, R. (2009). *The global financial crisis and the Malaysian economy: Impact and responses.* Kuala Lumpur: United Nations Development Programme (UNDP).

Ahmad, M.J. (2012). Outlook for Malaysian palm oil refineries in challenging times. Retrieved 24 May 2013 from http://www.poram.org.my/v1/poram/hb/Palm%20Oil%20Summit%202012.pdf

Bain, J.S. (1956). *Barriers to new competition.* Cambridge, MA: Harvard University Press. https://doi.org/10.4159/harvard.9780674188037

Bank Negara Malaysia. (2010). *Annual report 2009.* Kuala Lumpur: Bank Negara Malaysia.

Barham, B., & Ware, R. (1993). A sequential entry model with strategic use of excess capacity. *The Canadian Journal of Economics*, *26*(2), 286–298. https://doi.org/10.2307/135908

Barthwal, R.R. (2004). *Industrial economics: An introductory textbook.* New Delhi: New Age International (P) Limited.

Bikker, J.A., & Haaf, K. (2002). *Measures of competition and concentration in the banking industry: A review of the literature.* Netherlands: Central Bank of the Netherlands.

Brock, W.A., & Scheinkman, J.A. (1985). Price setting supergames with capacity constraints. *The Review of Economic Studies*, *52*(3), 371–382. https://doi.org/10.2307/2297659

Bunch, D.S., & Smiley, R. (1992). Who deters entry? Evidence on the use of strategic entry deterrents. *Review of Economics and Statistics*, *74*(3), 509–521. https://doi.org/10.2307/2109496

Charumbira, M., & Sunde, T. (2010). Seller concentration in the grain milling industry. *American Journal of Economics and Business Administration*, *2*(3), 247–252. https://doi.org/10.3844/ajebasp.2010.247.252

Choo, S.Y., & Abdul Jalil, S. (2014). Excess capacity and entry deterrence: The case of Malaysian palm oil refining industry. *Malaysian Management Journal*, *18*, 3–12.

Church, J.R., & Ware, R. (2000). *Industrial organization: A strategic approach.* Boston: Irwin McGraw-Hill.

Cotterill, R.W., & Haller, L.E. (1992). Barrier and queue effects: A study of leading US supermarket chain entry patterns. *The Journal of Industrial Economics*, *40*(4), 427–440. https://doi.org/10.2307/2950533

Cowling, K., & Waterson, M. (1976). Price-cost margins and market structure. *Economica, New Series*, *43*(171), 267–274. https://doi.org/10.2307/2553125

Department of Statistics Malaysia. (2018). *Statistics yearbook (1976–2018).* Putrajaya: Department of Statistics.

Duetsch, L.L. (1975). Structure, performance and the net rate of entry into manufacturing industries. *Southern Economic Journal*, *41*(3), 450–456. https://doi.org/10.2307/1056156

Ferguson, P.R., & Ferguson, G.J. (1994). *Industrial economics: Issues and perspectives.* New York: New York University Press. https://doi.org/10.1007/978-1-349-23306-9

George, K.D., Joll, C., & Lynk, E.L. (2000). *Industrial organisation: Competition, growth and structural change.* New York: Routledge.

Ginevičius, R., & Čirba, S. (2007). Determining market concentration. *Journal of Business Economics and Management*, *8*(1), 3–10. https://doi.org/10.3846/1611-1699.2009.10.191-198

Ginevičius, R., & Čirba, S. (2009). Additive measurement of market concentration. *Journal of Business Economics and Management*, *10*(3), 191–198.

Gopal, J. (1999). Malaysia's palm oil refining industry: Policy, growth, technical change and competitiveness. In K. Jomo, G. Felker, & R. Rasiah (Eds.), *Industrial technology development in Malaysia: Industry and firm studies* (pp. 360–395). London: Routledge.

Günalp, B., & Cilasun, S.M. (2006). Determinants of entry in Turkish manufacturing industries. *Small Business Economics*, *27*(2/3), 275–287. https://doi.org/10.1007/s11187-006-0021-z

Hannah, L., & Kay, J.A. (1977). *Concentration in modern industry: Theory, measurement and the U.K. experience.* London: Macmillan Press. https://doi.org/10.1007/978-1-349-02773-6

Hasan, H. (2007). Rent-seeking and industrial policy in Malaysia. In K. Jomo (Ed.), *Malaysian industrial policy* (pp. 156–178). Singapore: NUS Press.

Heflebower, R. (1967). The theory and effects of nonprice competition. In R. Kuenne (Ed.), *Monopolistic competition theory: Studies in impact – Essays in honor of Edward H. Chamberlin* (pp. 188–190). New York: John Wiley.

Horowitz, A., & Horowitz, I. (1968). Entropy, Markow processes and competition in the brewing industry. *Journal of Industrial Economics*, *16*(3), 196–211. https://doi.org/10.2307/2097560

Hueth, B., & Marcoul, P. (2006). Information sharing and oligopoly in agricultural markets: The role of the cooperative bargaining association. *American Journal of Agricultural Economics*, *88*(4), 866–881. https://doi.org/10.1111/j.1467-8276.2006.00903.x

Kramaric, T.P., & Kitic, M. (2012). Comparative analysis of concentration in insurance markets in new EU member states. *International Scholarly and Scientific Research & Innovation; World Academy of Science, Engineering and Technology*, *6*(6), 634–638.

Martin, S. (2010). *Industrial organization in context.* New York: Oxford University Press Inc.

May, D.E. (2012). Addressing biodiversity loss when international markets of agricultural commodities are oligopolistic. *Economics and Business Letters*, *1*(1), 53–57. https://doi.org/10.17811/ebl.1.1.2012.53-57

MPOB (Malaysian Palm Oil Board). (2018). *Malaysian oil palm statistics (2010–2018)*. Bangi: MPOB.

Nawrocki, D., & Carter, W. (2010). Industry competitiveness using Herfindahl and entropy concentration indices with firm market capitalization data. *Applied Economics*, *42*(22), 2855–2863. https://doi.org/10.1080/00036840801964666

Ng, L.F. (2012). Malaysia refiners' woes. Retrieved 24 May 2013 from http://research.cimb.com/index.php?ch=5036&pg=5083&ac=44861&bb=file

OECD (Organisation for Economic Co-operation and Development). (2013). Industry specialisation. In *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth* (pp. 214–237). Paris: OECD Publishing.

Sukpaiboonwat, S., Piputsitee, C., & Punyasavatsut, A. (2014). Measuring the degree of market concentration in Thailand insurance industry. *Asian Social Science*, *10*(4), 214–232. https://doi.org/10.5539/ass.v10n4p214

Ukav, I. (2017). Market structures and concentration measuring techniques. *Asian Journal of Agricultural Extension, Economics and Sociology*, *19*(4), 1–16. https://doi.org/10.9734/AJAEES/2017/36066

USDA (United States Department of Agriculture). (n.d.). *Malaysia palm oil domestic consumption by year (2010–2018)*. United States: USDA.

Viseur, R. (2016). Open concentration index: Measure of market concentration in open source industry. *Proceedings of the 12th International Symposium on Open Collaboration*, A6, 1–4. https://doi.org/10.1145/2957792.2957796

Waldman, M. (1991). The role of multiple potential entrants/sequential entry in non-cooperative entry deterrence. *The RAND Journal of Economics*, *22*(3), 446–453. https://doi.org/10.2307/2601058

Ye, K.H., Lu, W.S., & Jiang, W.Y. (2009). Concentration in the international construction market. *Construction Management and Economics*, *27*(12), 1197–1207. https://doi.org/10.1080/01446190903222429